

CORE QUESTIONS and REPORT TEMPLATE for FY 2014 NSF COMMITTEE OF VISITOR (COV) REVIEWS

Guidance to NSF Staff: This document includes the FY 2014 set of Core Questions and the COV Report Template for use by NSF staff when preparing and conducting COVs during FY 2014. Specific guidance for NSF staff describing the COV review process is described in the "COV Reviews" section of NSF's Administrative Policies and Procedures which can be obtained at <https://inside.nsf.gov/aboutnsf/hownsfworks/rolesresponsibilities/Pages/Committee-of-Visitors.aspx>¹

NSF relies on the judgment of external experts to maintain high standards of program management, to provide advice for continuous improvement of NSF performance, and to ensure openness to the research and education community served by the Foundation. Committee of Visitor (COV) reviews provide NSF with external expert judgments in two areas: (1) assessments of the quality and integrity of program operations and program-level technical and (2) managerial matters pertaining to proposal decisions.

The program(s) under review may include several sub-activities as well as NSF-wide activities. The directorate or division may instruct the COV to provide answers addressing a cluster or group of programs -a portfolio of activities integrated as a whole -or to provide answers specific to the sub-activities of the program, with the latter requiring more time but providing more detailed information.

The Division or Directorate may choose to add questions relevant to the activities under review. NSF staff should work with the COV members in advance of the meeting to provide them with the report template, organized background materials, and to identify questions/goals that apply to the program(s) under review.

For programs using section IV (addressing portfolio balance), the program should provide the COV with a statement of the program's portfolio goals and ask specific questions about the program under review. Some suggestions regarding portfolio dimensions are given on the template. These suggestions will not be appropriate for all programs.

Guidance to the COV: The COV report should provide a balanced assessment of NSF's performance in the integrity and efficiency of the **processes** related to proposal review. Discussions leading to answers of the Core Questions will require study of confidential material such as declined proposals and reviewer comments. **COV reports should not contain confidential material or specific information about declined proposals.** The reports generated by COVs are made available to the public.

We encourage COV members to provide comments to NSF on how to improve in all areas. as well as suggestions for the COV process, format, and questions. For past COV reports, please see <http://www.nsf.gov/odloial/activities/cov/>

¹ The COV Reviews section has three parts: (1) Policy, (2) Procedures, and (3) Roles & Responsibilities.

FY 2014 REPORT TEMPLATE FOR
NSF COMMITTEES OF VISITORS (COVs)

The table below should be completed by program staff.

Date of COV: June 11-13, 2014

Program/Cluster/Section: All MCB Clusters: CDF, MB, GM, SSB

Division: Molecular and Cellular Biosciences (MCB)

Directorate: BIO

Number of actions reviewed: 179 (Externally Reviewed)

Awards: 30

Declinations: 149

Other: 9 Internally Reviewed (7 awards, 2 declines)

Total: 188 proposals. 208 proposals are available in the eJacket COV module due to lead collaborative proposals being added.

Total number of actions within Program/Cluster/Division during period under review:
4161 (Externally and Internally reviewed in FY 11-13)

Awards: 700

Declinations: 3461

Other:

Manner in which reviewed actions were selected:

A sample size of -190 proposals would give us a 7% margin of error based on the total number of proposal actions (4161).

Proposals are selected in a stratified manner, where a sample of awards and declines were randomly selected but are proportionate to the amount of awards and declines made in a specific FY. More information on the sample size can be found under document F. All Proposals, Awards, and Sample under the "Summary of Sample" tab.

COV Membership

Dr. Angel Garcia (Chair)
Rensselaer Polytechnic Institute
Field Of Study: Computational Biophysics and protein folding

Dr. Irina Artsimovitch
Ohio State University
Field of Study: Transcriptional mechanism

Dr. Malcolm Campbell
Davidson College
Field of Study
Synthetic Biology

Dr. Steve Evans
Dow AgroSciences
Field OF Study: Computational Biology, biochemistry

Dr. Susan Gregurick
National Institute of General Medical Science
Field of Study: Systems Biology

Dr. Juliette Lecomte
Johns Hopkins
Field Of Study: NMR spectroscopy and protein structure

Dr. Herbert Levine
Rice University
Field of Study: Theoretical Physics of cells

Dr. Susan Marqusee (Co-Chair)
UC Berkeley
Field Of Study: Protein folding and design

Dr. Gaetano T. Montelione
Rutgers
Field of Study: Protein Structure & Function

Dr. Basil J Nikolau
Iowa State University
Field Of Study: Metabolomics and metabolic engineering

Dr. Mary Jo Ondrechen
Northeastern University
Field of Study: Theoretical and computational chemistry and biology

Dr. Himadri Pakrasi
Washington University in St Louis
Field Of Study Systems Biology

Dr. Joan Slonczewski
Kenyon College
Field Of Study: Bacterial Stress resistance

Dr. Takita Sumter
Winthrop University
Field of Study: Protein structure-function, Gene regulation

Dr. Maria Elena Zavala
California State University Northridge
Field of Study: Plant Cell Biology

Executive summary

The COV is impressed by the visionary leadership and scientific scope of MCB. The science funded by MCB focuses on the critical foundations of biology. Recent scientific highlights include: 1) the discovery of the Cas9 system, which has spawned an entire new industry for genome engineering; and 2) fundamental research, funded by Molecular Biophysics, developing the energy-landscape theory from a physics perspective have spurred new paradigms for the functional, structural, and dynamic properties of biomolecules, including intrinsically disordered proteins, and the role of biomolecular dynamics in molecular recognition. Long-term impacts of MCB-funded foundational research were recognized in the 2013 Nobel Prizes, where three of the Chemistry and Physiology and Medicine award winners. One of them continues to be funded by MCB to this day.

MCB funds a critical leading edge of science. Their articulate vision and goals are apparent in all of their programs. The COV found MCB's awards process to be transparent, fair, and equitable, and commend their responsiveness to suggestions, criticism and continual self-evaluation. They lead the way and serve as a role model for diversity in science, thought and people.

MCB is uniquely poised to act as the intellectual hub for interdisciplinary research across all areas of biology, among the BIO divisions and across Directorates. Examples include the formation and co-funding of two Physics Frontiers Centers (PFCs) focused on biology, and providing the natural intellectual home for BioMaPS, which was initiated by the Molecular Biophysics cluster within MCB. These interactions move science forward in a synergistic and catalytic manner.

The COV is impressed by MCB's flexibility in identifying emerging fields, which is demonstrated by the rapid recognition of the area of synthetic biology and its incorporation into the MCB portfolio. The COV is also impressed by MCB's ability to think beyond the molecular aspects in recognizing the ethical, legal and social implications of synthetic biology. The Program Directors at MCB are engaged and interactive with their respective communities and able to recognize new directions quickly.

The division of MCB provides the perfect training hub for the future generation. MCB's portfolio directly addresses the basic research needs that are at the heart of President Obama's Bioeconomy Blueprint. In addition, the greater society and economy demands a workforce with quantitative scientific training at the interface of disciplines.

The overall BIO Directorate plays important key roles to the entire biological community. There are two unique strengths which distinguish NSF BIO from other agencies such as NIH, which focuses on fundamental scientific knowledge and its application to enhance our understanding of health and disease. The first is its strong programs in fundamental biology. The second is its position and access to interdisciplinary collaborations and co-funding with other areas of science such as MPS, ENG, EHR, CISE, GEO and SBE. MCB has been the hub and driving force in these interdisciplinary interactions, which are tremendously enabling to the entire scientific community. MCB commits significant funds to these scientific activities. This creates important interdisciplinary training and innovative research. The COV was pleased to discover that this second strength of MCB is appreciated by PDs of the other NSF Directorates.

Despite the enthusiastic recognition of the strengths of MCB by PDs, the general feeling is that these strengths might not be fully appreciated by the BIO AD office. Furthermore, there appears to be a growing tension within BIO, which may be detrimental to maintaining the excellent trajectory and future development of MCB. These tensions are evident at all levels, impacting the effectiveness of administrative staff, PDs, and the DD. They have a negative effect on the community, as well as within the BIO division. The COV strongly feels that this issue needs to be addressed quickly and at the highest level of NSF; i.e. by the Office of the Director of NSF.

The COV found that during the 2011-2013 period, MCB continued to identify and support outstanding science and education proposals. After careful analysis of the merit review process, the management of the program, and the portfolio of awards we conclude that the MCB Division is doing an outstanding job. This analysis is documented in the detailed responses to the posed questions.

The COV has the following general recommendations:

1. MCB must continue to provide an intellectual hub for key foundational research centered at quantitative, predictive, theory-driven biology at the molecular and cellular level.

This approach is vital to the advancement of the entire field of Biology. The proactive outreach and connections to other fields spawns new emerging areas of research. The co-funded interdisciplinary projects are an excellent complement to the important single-investigator research grants. This is a funding model of how NSF should work.

2. Seeking transparency for Division and Directorate vision, process and policy.

The COV became aware of concerns about morale within the Division. The COV has confidence in the management structure of MCB, and values the fundamental and multi-disciplinary program that MCB has developed via the portfolio of funded projects. The COV perceives a threat to this valuable program if morale in the Division becomes a distraction. There appears to be many recent and imminent changes in the organization; the COV is concerned about how these changes will impact the scientific community. The COV recommends greater transparency in the mechanisms used to recruit and fill key management positions in BIO (e.g., Division Director, Deputy AD, AD positions).

Morale and HR inconsistencies were noted by the administrative staff. Staff were proud of their performance and of the Division and its management; however, they feel as though their efforts go unrecognized by the Directorate as a whole and would benefit from more transparency in policies and hiring practices. Many of the staff do not have a clear sense of their career development opportunities or potential for upward mobility.

3. Generate mechanisms to foster interactions among the divisions of the BIO

Directorate.The entire field covered by the BIO directorate is moving towards more quantitative and predictive science. More coordination and interaction within MCB would help all the divisions better realize their full potential. Mechanisms should be developed to provide incentives for collaborative funding among Divisions of the BIO Directorate.

The COV observed a general lack of cohesion and integration between Divisions of the BIO Directorate, and also among some clusters within MCB. In particular, Genetic Mechanisms Division seemed disconnected and not coordinated with the rest of the MCB team.

The COV recommends a regular strategic planning meeting involving PDs, DDs and ADs across the Bio Directorate in order to develop better cohesion and coordination of Bio funding activities. This will provide the opportunity to better integrate the Bio Directorate team.

4. Ease Domestic and Foreign Travel Restrictions.

The current restriction on travel budget is a detriment to the overall well-being of the MCB program. The PDs need to continue to have opportunities to travel to national and international meetings, and for other outreach activities as well as to various institutions to interact with funded PIs and with potential future PIs.

The ability of MCB program leaders to remain active participants in the greater scientific community is crucial to their effectiveness in managing the competitive review process, but more so in their ability to make quality judgments on proposals. Undue travel restrictions on MCB program leaders will jeopardize portfolio balance.

5. Generating a plan for broadened career development for MCB trainees.

The COV is concerned about the general challenge presented by the limited opportunities for Ph.D. and postdoctoral scientists who are being trained with NSF support, and the evolution of the scientific workforce and its diversity in the United States. How are MCB and NSF responding to

the Alberts et al. *PNAS* paper noting that only 8% of Ph.D. trained-scientists go to academic positions?

6. Evaluation, documentation and follow up on Broader impacts

We recommend that applicants and reviewers be instructed to address both aspects of Broader Impacts:

- a) What are the broader scientific and societal impacts of the proposed research, and
- b) What are the broader impacts associated with the supported personnel, such as education and outreach activities?

This will encourage better uniformity in the review process and level the playing field for applicants.

The Broader Impacts of the project to society should always be explicitly addressed and will aid in justification of awards to the general public.

Finally, annual reports and the Results of Prior Support sections of proposals should clearly outline progress towards the stated Broader Impact goals to ensure follow up.

7. Develop and Improve methods for communicating scientific achievements and the value of fundamental science.

Without basic science there will be no future translational research. This is a particular, but important, challenge for foundational areas such as those funded by MGB. An avenue should be identified to better publicize the highest quality scientific and educational highlights of funded projects.

8. Evaluation of the use and review of EAGER awards. The GOV has concerns about the mechanism and use of EAGER grants. Often they are not used for their intended purpose. Evaluations and funding decisions appear to be made primarily by a single PD. The GOV suggests that a more inclusive and transparent mechanism be developed, with evaluation by at least 2 PDs documented in the Review Analysis. The basis/rationale for using the EAGER mechanism should be made clear in the documented reviews. Other means for bridging funds on closed grants need to be developed.

9. Avoiding unnecessary conflict of interest (COI) restrictions:

We recommend that the terms, restrictions and definition of COI be re-evaluated and updated. The GOV is concerned that with the increased emphasis and funding for large collaborations and interdisciplinary projects, the 48-month restriction of coauthoring a paper will make it difficult to find qualified reviewers who do not have COI. A careful analysis of multi-PI publications might help to distinguish between close collaborations and one-time community projects.

10. Continue to implement the once per year submission cycle for proposals.

The COV appreciates the rationale for the recent implementation of a single annual submission date. The COV strongly believes that the pre-proposal mechanism should not be implemented by MGB.

MCB new research opportunities

MCB does an exemplary job in identifying and funding emerging scientific areas of research. To help MCB continue its excellent trajectory, the COV has identified potential emerging fields that arise from curiosity driven foundational science.

1. What **new opportunities** in molecular and cellular biosciences should the Division address?

- Alternative methods for training scientists for career paths that could extend beyond academia to curtail the "reverse brain drain"
- Development of bio-inspired design principles - from molecules to cells
- Predictive modeling of molecular and cellular physiology including metapopulations of microbes and plants
- Advanced imaging to interrogate dynamic changes in biological structures (microbes and plants)
 - Develop image and signal analysis tools in multiple length and time scales.
- Integrate chemistry/physics with genomics to discover and build predictive physiology
 - Current informatics-based models are using only "known" components - need a more comprehensive knowledge of the components (functionality, based on structure and thus chemical/physical principles)
- Develop new more sensitive and *in situ* analytical tools
 - collaborate with physics/chemistry/astronomy in the context of analytical instrumentation at a "distance", without disrupting the biology
- Role of dynamics in molecular recognition
- Experimental evolution as a tool to understand cellular function

2 How can the Division encourage interdisciplinary and integrative research in the cellular and molecular biosciences?

- MCB is doing a wonderful job in catalyzing interdisciplinary research. It should claim its place as THE program at NSF that promotes and nurtures quantitative biosciences.
- Co-fund proposals/workshops with other Directorates/Divisions

3 How can the Division **assess** the quality and impacts of science supported by the Division?

- Automated systems to track Publications, IPs, Patents and NSF-funded student outcomes without adding extra burden to investigators.
- Track new methods and software that are widely used in academia and industry
- Development of STCs within the MCB scope

4 How do we, as an organization that supports fundamental molecular and cellular research, promote **issue-inspired science**, such as research that addresses societal needs?

- MCB's primary mission needs to remain firmly grounded in fundamental science and technology - enhancing the scientific knowledgebase. However, the program needs to be nimble to respond quickly to national and international needs, *e.g.*, BP oil spill..
- Another important area is 'Education' - engaging students from all walks of life in an active learning process.
- Conduct research that provides the "fundamental generalizable principles" of the science that addresses and is at the core of "**issue-inspired science**".
- Convening forums for diverse community input to develop quantitative methods to assess societal impact of the emerging sciences being developed.

**INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES
AND MANAGEMENT**

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

- I. **Questions about the quality and effectiveness of the program's use of merit review process.** Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

<p style="text-align: center;">QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</p>	<p style="text-align: center;">YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</p>
<p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>The review methods for proposals are appropriate and effective. The vast majority of proposals are externally reviewed by at least three reviewers, and we support this model. There are a small number of proposals submitted under the EAGER and INSPIRE programs that are internally reviewed. We find the INSPIRE proposals to be very well vetted by multiple program directors. As a constructive suggestion, we urge that at least two program directors review each EAGER proposal, simply on the principle that such commitments of funds should reflect the judgment of more than one person.</p>	<p style="text-align: center;">Yes</p>
<p>2. Are both merit review criteria addressed</p> <p style="padding-left: 20px;">a) In individual reviews? yes</p> <p style="padding-left: 20px;">b) In panel summaries? yes</p> <p style="padding-left: 20px;">c) In Program Officer review analyses? yes</p> <p>Comments: We note that, while reviewers tend to give details of strengths and weaknesses in Intellectual Merit, they sometimes do not specify strengths and weaknesses in Broader Impacts. This problem is also observed sometimes in the panel reviews.</p>	<p style="text-align: center;">Yes</p>

The variation in interpretation and overall emphasis on the broader impacts was discussed by the COV. Some reviewers tend to think only of the broader impacts of the science to the field; others tend to cite only educational and outreach efforts under Broader Impacts. We suggest that applicants and reviewers be instructed to address both: What are the broader impacts of the proposed research and what are the broader impacts associated with the supported personnel such as education and outreach activities? The Broader Impacts of the project to society should always be explicitly addressed. This should encourage better uniformity in the review process and level the playing field for applicants. The Program Officer review analyses adequately address both review criteria.

<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments:</p> <p>We note considerable variability in the level of detail and degree of usefulness of the individual reviews. We view this as an inherent feature of a service performed by busy humans who are volunteering their time. However, the self study notes that, while non-substantive reviews are part of the review record, they "usually contribute little to the decision-making process." We applaud the Division for its vigilance in obtaining multiple, substantive reviews for all proposals and for basing decisions on the substantive reviews and we encourage the Division to continue these practices. We further encourage the Division to continue to seek solutions to the problem of promoting substantive reviews without prescribing a "checklist".</p>	<p>Yes</p>
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments:</p> <p>Yes, the panel summaries gave rationale and summary of panel consensus. We note that MCB supplies a template to the panels and this encourages panel summaries that convey the reasons for the assessment.</p>	<p>Yes</p>
<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>Yes, there is clear rationale for the decision for nearly all proposals. We do find a small number of the EAGER awards for which there was some sentiment that better justification for the decision could be provided. The basis/rationale for using the EAGER mechanism was not clear in the reviews.</p>	<p>Yes</p>

<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>Yes. the documentation to the PI provides adequate rationale.</p>	<p>Yes</p>
<p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>We commend the Division for its review system that clearly and consistently funds high quality, innovative, potentially transformative projects</p> <p>The quality of the reviews that the Division receives would be increased if reviewers were instructed about the different types of broader impacts. We recommend that reviewers be asked to break broader impacts down into both societal and scientific impacts.</p> <p>The quality of the reviews would increase if the Pis had to address, in the Results of Prior Support section of renewal proposals, the impact of their work in the areas of science, education, outreach, and society. Currently some Pis only discuss the scientific results and exclude the broader impacts of the prior supported project.</p> <p>We urge that, when Program Directors ask potential reviewers whether they are willing to review a particular proposal, at that stage only the Project Summary should be provided. Access to the entire proposal should only be given to reviewers who actually agree to review the proposal.</p> <p>We have a technical suggestion that will help future COVs: In the spread sheet with the data on the proposals, the Average Merit score is calculated excluding the reviews that give multiple ratings. We wondered why proposals with average scores of 5.0 were declined while proposals with an average score of 3.0 were funded. Upon examination, the former situation arises when a proposal is rated E by one reviewer and G/F by two other reviewers, for instance. We feel that the dual scores should be counted as half-integer scores; thus in this example the average score should be $(5 + 2.5 + 2.5)/3 = 3.3$. not the 5.0 that is currently reported. The latter situation is illustrated by another example, wherein a proposal that is scored as G by one reviewer and EN by three reviewers should be averaged as: $[3.0 + (3 \times 4.5)]/4 = 4.1$ and not 3.0 as reported.</p>	<p>N/A</p>

II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

SELECTION OF REVIEWERS	YES., NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments: COV members sampled a large number of jackets across the four MCB clusters. In nearly every instance, the reviewers had appropriate expertise/qualifications</p> <p>We appreciate the challenges in assembling a balanced panel, and the PDs do well, given logistical constraints. While in the small minority, we did find a few examples where panel members with high expertise in the necessary area did not review a proposal. Some reviews were inappropriately brief, which may be associated with the time constraints of volunteer reviewers and unrelated to their expertise.</p> <p>Based on the previous COV, MCB has relied more on in-panel reviews and less on ad hoc reviewers who are not present to explain their views. We think in-presence reviewing is a good practice that should be continued to ensure an open discussion and consensus decisions.</p>	Yes
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments: In every case where COI was known, appropriate actions were taken by the panel members and the PD. We do note that with increased collaborations and interdisciplinary projects, the 48-month restriction of coauthoring a paper will make it difficult to find qualified reviewers who do not have COI. A careful analysis of multi-PI publications could be used to distinguish between close collaborations and one-time community projects.</p>	Yes

III. Questions concerning the management of the program under review. Please comment on the following:

MANAGEMENT OF THE PROGRAM UNDER REVIEW

1. Management of the program.

- The overall management of the program is outstanding, and provides a model of how a high quality NSF Division should be managed. Most critical to the mission of the division is its efficient and high quality proposal review process. Panel reviews are a Recommendation to PD. After the panel reviews, most of the decisions are made by the individual PDs who are very knowledgeable in their respective areas.
- The current restriction on travel budget is a detriment to the overall well being of the MCB program. The PDs need to continue to have opportunities to travel to national meetings, and for other outreach activities as well as to various institutions to interact with funded PIs and with potential PIs.
- Currently, proposals are accepted once per year (mid-November). Beginning investigators have two opportunities to submit proposals, because they can also apply for CAREER proposals in July for which they receive the decisions by early October. The COV however, is concerned that the PIs of declined CAREER proposals may not have sufficient time (6 weeks) to resubmit to the regular mid-November deadline, since the way a CAREER proposal is put together is very different from a regular proposal.
- The COV became aware of concerns about morale within the Division. The COV has confidence in the management structure of MCB, and values the fundamental, and multi-disciplinary program that MCB has developed via the portfolio of funded projects. The COV perceives a threat to this valuable program if morale in the Division staff becomes a distraction. There appears to be many recent and imminent changes in the organization, and the COV is concerned about how this will impact the scientific community. The COV recommends greater transparency in the mechanisms used to recruit and fill key management positions in BIO (e.g., Division Director, Deputy AD, AD positions).
- The program appears to be understaffed. The COV recommends that MCB maintain the staff at a reasonable level.
- Morale and HR inconsistencies were noted by the administrative staff. Staff were proud of their performance and of the division and its management, however they feel as though their efforts go unrecognized by the Directorate as a whole and would benefit from more transparency in policies and hiring practices. The COV noted a lack of clear professional development opportunities. These issues present a threat to the division as they may lead to unwanted turnover. The COV did question whether the NSF-wide Pathways program was fulfilling its stated mission, as the such talented employees seem to be in an untenable situation -working 40 hours and going to school with no mentorship structure for future employment.

2. Responsiveness of the program to emerging research and education opportunities.

Responsiveness of the program to emerging research and education opportunities.

- MCB funds the leading edge of science. The program management has been highly

proactive and responsive to new developments and emerging areas in the scientific community. As an example, since the previous COV meeting, MCB has changed the names and refocused the missions of the four clusters, creating a new Synthetic and Systems biology cluster. Overall, the COV applauds this responsiveness and proactive evolution of the Division to emerging research and education opportunities.

- MCB PDs have extensive interactions with their PI communities and with PDs in other NSF divisions. They attend and participate in scientific conferences and workshops and visit individual laboratories and centers. Most are well-established scientists in their own rights, and/or rotating visiting scientists. This mix provides both institutional memory and consistency, and appropriate turnover, which brings new ideas and perspectives to the division. The extensive interactions with the community provide the staff with significant expertise in the field. This is critical as it provides them with the knowledge and experience they need to reliably reprioritize recommendations from the panels regarding which grants to fund. Within MCB this process appears to be working very well.
- MCB does an outstanding and commendable effort in co-funding proposals with other divisions -30% of MCB grants are jointly funded with other Divisions. This powerful inter-division cooperation is a special strength of how MCB operates. It has really evolved from the unique strengths of some key permanent PDs in the MCB division. This proactive outreach to the other Divisions allows funding of exciting new interdisciplinary areas. These co-funded interdisciplinary are an excellent complement to the important single-investigator research grants. *This is a funding model of how NSF should work.*
- The interdisciplinary interactions are very dependent on the personalities and openness of the MCB Division Directors. For example, PD Kamal Shukla and MCB have made a big difference in creating and facilitating interactions between BIO and other directorates of the Foundation
- The COV also discussed at length the roles of MCB in the BioMAPS and BRAIN initiatives. BioMaPS - Projects are at the intersection between Biology, Math, Physical Sciences, and Engineering. PDs Kamal Shukla (BIO) and Denise Caldwell (PHYS) initiated a BIOMAPS-like process even before the program was established. The program has brought new funds to MCB, which are used to create synergies within the Division, across the BIO Directorate, and between various Directorates at NSF (i.e., MPS, ENG, etc). It has allowed funding of exciting new areas in molecular biophysics, cellular dynamics, genetic mechanisms, synthetic biology, and systems biology. This important and high impact NSF-wide program, which was nurtured and developed by the MCB program staff, is a tremendous success and a credit to the Division.
- The national BRAIN Initiative provides only modest funding to NSF. The NSF funding for this program is maintained and coordinated by at the BIO Directorate level -so it can be distributed in any Division. This is an exciting new program in which MCB is poised to make significant and central contributions, particularly in the areas of cellular dynamics, genetic mechanisms, molecular biology, and systems biology.
- The COV also discussed NSF Ideas Labs. In this funding mechanism \$8-10 Mis provided to fund three to four 3 Yr projects meant to address emerging and "potentially transformative" scientific areas. Direct submissions are also solicited. MCB has been involved in Idea Labs right from the start of this funding mechanism. MCB has funded only a small number of these. The COV recognized that in order to evaluate this program, the value and impact of this funding mechanism needs to be assessed based on the awards that have been made in the last few years.
- Early Concept Grants for Exploratory Research (EAGER) and CREATIV/INSPIREs are additional examples of how MCB funds high-risk projects. However, the COV is concerned that the 12-month funding cycle can negatively impact Responsiveness to Emerging Areas. Although the Division has attempted to address this using the internally reviewed EAGER mechanisms, a designated mechanism is needed to allow submissions under special circumstances, for eer-review, that is not limited to a single deadline per ear.

- The Division has been very proactive in developing a portfolio of "Innovative" and "potentially transformative" grants. This should indeed be a goal of the MGB. However, these terms are subjective and are often difficult to assess by reviewers or PDs.
- The GOV also discussed at length how EAGER and INSPIRE grants are awarded. Reviews for intellectual merit are sometimes quite sparse. The GOV recommends a more rigorous and transparent rationale for awarding EAGER grants. In some cases they are probably well justified, but the documentation on the funding decision is sometimes quite sparse. EAGER grant evaluations and funding decision appear to be made primarily by a single PD; the GOV has some concerns about this mechanism and suggests that a slightly more inclusive and transparent mechanism be developed, possibly evaluation by at least 2 PDs.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

- MGB supports and participates in high-value community driven Workshops (e.g. Protein Design Workshop) - these are very valuable to these specific research fields, and in guiding the development of the portfolio.
- A healthy ratio of rotating PDs also adds to the vitality of the portfolio and retains a healthy interaction between MCB and the community. The COV recommends that the ratio of "rotating" and permanent PDs be maintained and not be skewed with too few rotating PDs. Rotating PDs are important in maintaining a dynamic, scientifically up to date management structure.
- The COV is concerned about the general challenge presented by the limited opportunities for Ph.D. and postdoctoral scientists that we are training through NSF support, and the evolution of the scientific workforce in the United States. How are MCB and NSF responding to the Alberts et al *PNAS* paper, noting that only 8% of Ph.D. trained-scientists go to academic positions.

4. Responsiveness of program to previous COV comments and recommendations.

Comments:

- The Division has appropriately addressed many issues raised by the past COV. As a group, they have strategically and thoughtfully responded to these extensive comments and suggestions. A very extensive response has been provided to past COV comments. The proactive responsiveness of MCB staff to the needs and wishes of the community (represented by the COV) is a commendable strength of MCB and its leadership.
- In particular, responses have included refinement of the Mission Statement, the development and expansion of the Synthetic and Systems Biology cluster, and maintaining the confidentiality of the submitted proposals by limiting their distribution by only providing the Abstracts when soliciting *ad hoc* reviewers. In response to the COV, PDs have added PO comments to many proposals when the funding decision deviated from the panel recommendation or when the panel summaries omitted some critical aspects of the panel discussion
- The previous COV made specific recommendations regarding the balance of large vs. small scale science, and hypothesis driven vs. discovery-base research. This led to extensive discussions within the MGB Division. During the evaluation period, the Division funded 29 projects with average annual budget of \$380,000 or higher. Many of these large grants are

for discovery-driven research. Hence it appears that there is a good balance between priorities for discovery-based research and hypothesis-driven research.

- Regarding EAGERs, the previous COV recommended that a minimum of two PDs approve the requests. The COV noted that 23 of 28 EAGER proposals were approved. Discussion with MCB PDs indicate that most EAGERs are pre-screened as short pre-proposals, explaining the apparent high success rate, and that it is in fact standard practice to involve multiple PDs in assessing EAGER proposals. However, in reviewing the documentation in Review Summaries, EAGERs typically appeared to be approved by a single PD. It is important to fully document how decisions on internally reviewed grants are made. If in fact there is cluster-wide assessment of the EAGERs, and final approval by the DD, this should be documented in the Review Summaries.
- The previous COV had extensive suggestions regarding their concerns on inconsistent interpretation of Broader Impacts by investigators and by reviewers. MCB has contributed to efforts by the Foundation to address these concerns. Based on the recommendation of the National Science Board, the Foundation has revised the broader impacts review criteria. The revision and implementation occurred during the evaluation period. MCB even funded a grant for a workshop on broader impacts. The MCB solicitation now encourages PIs to include budget items for supporting broader impacts activities. However, in the view of the current COV, the Broader Impacts issue remains inadequately resolved. Our recommendation is that investigators are specifically asked to address two Broader Issue criteria: 2A What is the impact of the proposed research for the broader scientific community and/or for society? 2B. What will be the impact on education and society of the investigators outreach efforts?

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

<p style="text-align: center;">RESULTING PORTFOLIO OF AWARDS</p>	<p style="text-align: center;">APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</p>
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>To evaluate the balance of the MCB-wide portfolio, we examined the cluster post-panel reports, the self-study documentation, and a random sampling of funded awards. In sum, the MCB awards span an appropriately broad array of disciplines and sub-disciplines. In each cluster the received proposals span the entire range of scientific areas and the funded awards span the range in a similar distribution with a notable and appropriate bias towards the identified emerging areas. There is a clear emphasis on proposals focused on quantitative, predictive, theory-driven biology in all clusters. The entire portfolio, particularly the Molecular Biophysics cluster, shows a real emphasis on inter-disciplinary proposals, and those with cross-fertilization between theory, computation and experiment This approach is vital to the advancement of the field of Biology and the COV fully supports it</p>	
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Yes, most awards seem to be appropriate in size and duration. The mean size of an award is ~\$190K/year with a mean duration of just over three years (Table 12 of the self study). However, the broad range of both size and duration, reflect the diverse array of types of projects funded (Figures 5,6 of self study). Research-driven proposals appear to have a four to five year duration, giving PIs appropriate time for demonstration of significant progress before submitting renewals. Proposals are generally funded at the requested level with appropriate oversight for any budgets that are unjustified Figure 5 of the Self Study demonstrates that greater than 90% of the proposals are funded within 5-10% of the requested amount.</p> <p>Comments: It would have been helpful to provide data segregated by award type to evaluate the size and duration of projects, especially the conference awards, as these tend to be small in size and duration. skewing the aggregate data.</p>	

<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Yes, the portfolio contains projects that are innovative and/or potentially transformative.</p> <p>Comments:</p> <p>The designation of 'transformative' appears often to arise organically from input during the review process rather than as an exclusive result of solicitation of 'transformative' projects.</p> <p>The MCB Program Directors use several tools to manage the composition of the portfolio, including EAGER and INSPIRE grants, but also by seeding thought areas through extensive use of conference funding. The Program Directors also manage a portion of new proposals towards emerging areas.</p> <p>The ability of MCB program leaders to remain active participants in the greater scientific community is crucial to their effectiveness in managing the competitive review process, but more so in their ability to make quality judgments on internally reviewed proposals. Undue travel restrictions on MCB program leaders will jeopardize portfolio balance.</p> <p>While the prospective identification of transformative research arguably is challenging, MCB might benefit from optimizing the "Highlights" identification process to document such projects retroactively. The delay in impact to the scientific community might not fit an ~3 year COV review cycle.</p> <p>An example of innovative/transformative work not highlighted is the efforts on CRISPR funded by MCB. The scientific inquiry was in the area of bacterial acquired immunity, but the mechanism discovered enabled relatively facile targeting of a nuclease to specific sites in prokaryotic and eukaryotic genomes. The work has catalytically expanded to enable genome engineering and other in vitro and in vivo sequence specific detection. Within two years the rate of publications based on CRISPR/Cas9 has increased dramatically, with ~240 citations in pubmed since 2011 and several journals declaring it the molecule of the year.</p> <p>Comment: It might be useful to keep track of awards marked as transformative during panel discussions.</p>	<p>Yes</p>
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <ul style="list-style-type: none"> • MCB has done an excellent job of fostering interdisciplinary science. One might argue that it has the most active and extensive efforts within the NSF to capitalize on and contribute to the increasing multi-disciplinary character of the approaches needed to solve some of our most challenging scientific and societal problems. <p>This effort takes on many forms, including:</p>	<p>Yes</p>

<ul style="list-style-type: none"> • An amazingly high percentage of research awards that involve other disciplines and that are co-funded by other divisions and directorates. • Participation in high-profile initiatives, including the INSPIRE process (which requires multi-directorate funding), the Physics Frontier Center program (which has enabled the formation of several centers devoted to biological physics), and the BIOMAPS program. The latter can in fact be traced back to initial contacts between MCB (through Kamal Shukla, molecular biophysics PD) and Physics (through Denise Caldwell) to specifically couple complex physics research to the scientific challenges of the molecular and cellular milieus. This idea has now spread to an NSF-wide effort and indeed to a national priority. <p>In short, the recruitment of many parts of the NSF, including other parts of biosciences as well as chemistry, physics, math, computer science, and engineering, all from other Directorates, to actively collaborate with MCB in its scientific and educational agendas has been an unqualified success.</p>	
<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>The MCB supports research from across the USA. There is an uneven distribution of the awards across the USA. A broad stretch in the mid-west of the US has fewer proposals funded than expected (less than 12%-17%). The distribution of funded proposals appears to be greater along the east and west coasts. Some states that appeared to be highly successful, for example Rhode Island (26 awards/SO proposals) while proposals from South Carolina (3 awards/48 proposals) are less successful than expected. Pis from several states and a territory did not submit any successful proposals over the three years examined: South Dakota, Maine and Puerto Rico. In some of these cases, small grants such as GRC proposals dominate and skew these statistics.</p> <p>Comments: Perhaps special NSF regional grant writing workshops or support for Pis to attend grant writing workshops would help improve the success of Pis from states with a record of preparing proposals that are not fundable.</p>	<p>Yes, with some outliers.</p>
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Despite the directorate's stated concerns about the overall low numbers of proposals submitted from PUIs, the panel found that the MCB has a</p>	<p>Yes</p>

good representation of awards to different types of institutions. Notably, an RUI has been awarded to a PI at a community college.

7. Does the program portfolio have an appropriate balance of awards to new investigators?

Yes

NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.

Comments:

Typically 8-15% of the awards in MCB have been made to new investigators and this was favorably received. The overall enthusiasm for attention to the needs of new investigators is strong. However, the panel notes that the scientific community will likely benefit from an equal level of attention to supporting well established or mid-career scientists who may be entering new research areas.

8. Does the program portfolio include projects that integrate research and education?

Yes

Comments:

The review panels are very interested in the educational component of Broader Impacts. Most funded applications promise exciting outreach programs involving education of undergraduates and/or high school students. However, the annual reports need to require PIs explicitly to report their follow-through on these programs. Also, succeeding applications should require PIs to mention their promised educational and outreach programs in the "progress report" section of the application.

The program does a good job of supporting RUI applications that integrate undergraduate research with education. It is emphasized that the science must come first; only good research can be supported, and should result in undergraduate coauthored publication in peer-reviewed journals.

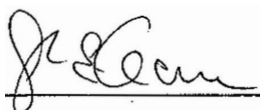
The number of RUI applicants is small, and few RUI PIs develop a program sustained over renewals. It would help to publicize models of how RUI awardees develop and maintain a successful lab with undergraduates publishing their work.

<p>9. Does the program portfolio have appropriate participation of underrepresented groups'?</p> <p>Comments: Women have an above average rate of funded proposals. The overall number of women applicants, however, is only about a third the number of male applicants. NSF should --Look at the numbers of women in departments applying to MCB, to see whether proportionate numbers are applying. --Consider whether obstacles exist to women applying, and how women might be encouraged to apply.</p> <p>The percentage of minority applicant awards is above average, and the panels make extra efforts to fund minority applicants in the excellent and very good categories. The overall number of minorities in scientific departments remains low. NSF might reconsider ways of encouraging minority scientists, for example by a Visiting Professorship that enables a young scientist to spend a year conducting research while developing mentoring programs for minority students.</p>	<p>Yes</p>
<p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> <p>MCB has done a very good job in aligning its internal priorities with overall NSF missions and with national objectives. It is extremely noteworthy that an initiative that started in MCB to engage physical science and engineering with biological investigation has gone viral, as the BIOMAPS program and with a recent OMB research letter. The case that this area is truly a national priority was made very persuasively in an NAS study on the role of physical science in biology and MCB has been the NSF leader in this area. MCB is also contributing to other areas of far-reaching importance such as nanotechnology and bio-economy; see for example the National Bioeconomy Blueprint from OSTP. Within the NSF, MCB's strategy of using all available avenues and partnerships to further its basic scientific, educational, and diversity-building missions is completely in keeping with the agency's overall goals in these areas.</p>	<p>Yes</p>
<p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p>	

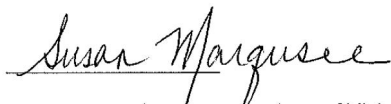
² NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

<p>The MCB portfolio includes critical support for fundamental breakthroughs on the molecular and cell biology of bacteria and plants. For example, the groundbreaking discoveries on CRISPR involve fundamental principles of cell biology unique to bacteria--but which gave unexpected applications to biotechnology.</p>	
--	--

SIGNATURE BLOCK:



For the 2014 BIO MCB COV
Dr. Angel Garcia
Chair



Dr. Susan Marqusee
Co-Chair